SOLAR/2003-79/06

Monthly Performance Report

SCATTERGOOD SCHOOL

JUNE 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT
SCATTERGOOD SCHOOL
JUNE 1979

I. SYSTEM DESCRIPTION

A solar energy system is installed at Scattergood School near Westbranch, which is located 35 miles southeast of Cedar Rapids, Iowa. The system is designed to supply approximately 75 percent of the annual space heating requirements for the gymnasium, as well as 75 percent of the hot water for the student locker room. This solar energy system is also used to dry grain in a modified grain silo located on the site adjacent to the gymnasium. The site has an array of 128 flat-plate collectors, manufactured by Solaron, with a gross area of 2,496 square feet. The collectors face south at an angle of 50 degrees from the horizontal. Collected solar energy is stored in a pebble bed containing 64 tons of stones for space heating and in two 120-gallon tanks to permit DHW preheating. Air is the medium used for transferring energy from the collector array to the pebble bed or directly to the gymnasium.

When solar energy is insufficient for space heating, two 250K Btu propane gas heaters furnish auxiliary energy. Auxiliary heating for hot water is provided by a 52-gallon domestic water heater containing standard electric resistance, immersion heater elements. The solar energy system is manually converted to summer mode operation by opening and closing slide gate dampers which isolate the storage from the solar energy system. The control system switch then is positioned to the summer mode.

The system, shown schematically in Figure 1, has five modes of solar operation.

<u>Mode 1 - Collector-to-Space Heating</u>: This winter mode is entered when two conditions occur simultaneously. The first condition occurs when the collector outlet temperature exceeds the gymnasium temperature by at least 45°F. The second condition occurs when there is a space heating

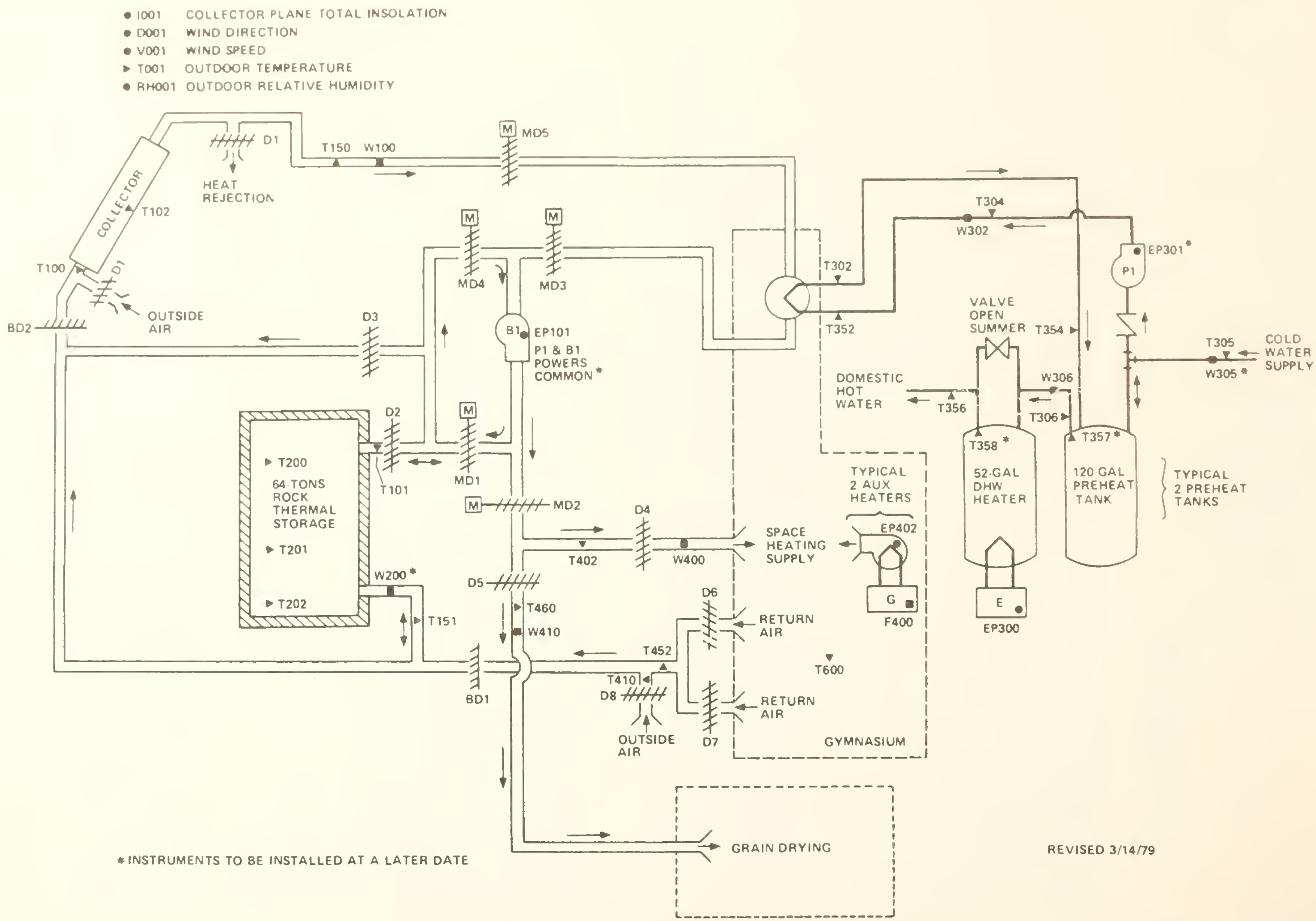

Figure 1. SCATTERGOOD SCHOOL SOLAR ENERGY SYSTEM SCHEMATIC

demand indicated by the manually preset, two-stage thermostat. The air heated by the collector is circulated by the air-handling unit between the collector and the gymnasium through ducts containing motorized dampers. In this mode, the heated air bypasses the rock thermal storage as it returns to the collector. This mode continues until either the collector outlet temperature no longer exceeds the collector inlet temperature by at least 30°F, or the demand for space heating is satisfied. Stage one of the thermostat operates when solar energy is needed, and stage two operates in conjunction with stage one to activate the auxiliary heaters to supplement solar energy when the gymnasium temperature drops below a level determined by the thermostat setting.

<u>Mode 2 - Storage-to-Space Heating</u>: This winter mode is entered when these three conditions occur simultaneously: 1) there is a demand for space heating, 2) the collector loop is not active, and 3) the temperature in the rock thermal storage is 90°F or higher. Air is drawn through the ducts from storage and circulated through the air-handling unit to the conditioned space and returned to storage; the air bypasses the collector.

<u>Mode 3 - Collector-to-Storage</u>: This winter mode is entered when the collector outlet temperature exceeds the gymnasium temperature by at least 45°F, and Mode 1 is not required. Heated air is drawn from the collectors, via the air-handling unit, and is circulated between rock thermal storage and the collectors. This mode continues until the collector outlet temperature no longer exceeds the collector inlet temperature by at least 30°F.

<u>Mode 4 - Collector-to-Water Preheating</u>: This summer operation mode is entered when two conditions are met. The first condition is that there is a request for hot water. The second condition occurs when the collector outlet temperature exceeds the gymnasium temperature by 45°F. Heated air drawn from the collector is circulated via the air-handling unit through the ducts past an air-to-liquid heat exchanger and returned

to the collector (the air bypasses the rock thermal storage). Simultaneous to collector air flow, pump P1 is turned on and DHW preheat tank water is circulated through the air-to-liquid heat exchanger, where solar energy is obtained and used to increase the temperature of the DHW preheat tank. This mode continues until the temperature in the preheat tanks reaches 140°F, or until the collector outlet temperature no longer exceeds the collector inlet temperature by at least 30°F. This preheated water is stored in two 120-gallon tanks and delivered on demand to the 52-gallon DHW heater. Water can also be preheated in Modes 1 and 3 during the heating season, when energy collection is occurring and a hot water demand exists.

Mode 5 - Grain Drying: This manually controlled winter mode is utilized to reduce the moisture of grain stored in a bin near the gymnasium. This mode operates in the fall and spring to utilize excess solar energy. Manual dampers D8 and D5 (Figure 1) are opened, and manual dampers D4, D6 and D7 are closed. This action provides a path for outside air to be drawn by the air-handling unit through the collectors, where it is heated, and then supplied to the grain bin. The mode is entered by raising the gymnasium thermostat to artificially produce a demand for space heating to the control system. The mode is terminated manually either after solar energy is exhausted, or after the grain reaches the desired dryness.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluations Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The Scattergood School solar energy system operated in the winter space heating modes until June 25, 1979, when the system was converted to summer operation. The system furnished 97 percent of the 12.13 million Btu required to satisfy the combined space heating and hot water demand. The operation of these subsystems resulted in a savings of 19.19 million Btu of fossil fuel energy (210 gallons of propane) at an expense of 0.28 million Btu of electrical energy (83 kwh).

B. Weather

The insolation available on the collector array during the month was an average of 1,500 Btu/ft^2-day, which is near the 1,579 Btu/ft^2-day estimated for the month. This estimate is computed by using an algorithm to estimate the insolation on a tilted surface from long-term insolation data (on a horizontal surface) obtained from SOLMET Volume 1 - User's Manual. The horizontal insolation data from Des Moines, Iowa and Moline, Illinois were used to estimate the horizontal insolation for Westbranch, Iowa.

The average measured outside ambient temperature was 70°F, which is 1°F lower than the 71°F long-term prediction from the average of Des Moines, Iowa and Moline, Illinois temperature data obtained from Climatography of the United States No. 81 (By State).

C. System Thermal Performance

Collector - Of the 112.33 million Btu of incident solar energy on the collector array during June, 60.24 million Btu were incident on the array when the collector was operating. The system collected 18.47 million Btu, or 16 percent of the available insolation at an expense of 0.28 million Btu of electrical operating energy. The system collected 30 percent of the insolation available during collector operation.

From collected energy, 3.19 million Btu were delivered to the hot water preheat tanks, 8.69 million Btu were delivered to storage, and 6.45 million Btu were delivered directly to the loads. Consequently, there was an indicated loss of approximately 3.33 million Btu from the transport loops in the subsystem.

Storage - The rock thermal storage subsystem received 8.69 million Btu of collected solar energy. The subsystem furnished 5.07 million Btu to meet the space heating demand. The energy lost from storage amounted to 1.84 million Btu. A portion of the storage energy loss is believed to have been transmitted to the gymnasium, thus contributing to the cooling requirements of the gymnasium. The monthly storage efficiency was 56 percent. The storage subsystem was bypassed, beginning July 25, when the system was converted to the summer mode.

Domestic Hot Water Load - Hot water consumption for the month was 1,076 gallons, or 36 gallons per day. The hot water load was 0.62 million Btu, of which 50 percent was supplied by solar energy. In order to satisfy this load and to maintain the DHW supply at an average temperature of 134°F, 4.04 million Btu of thermal energy were supplied to the DHW and preheat tanks. The difference between the energy added to the tanks and the hot water load are thermal losses from the DHW subsystem. The total thermal loss from the subsystem was 3.42 million Btu. The 4.04 million Btu of energy transferred to the DHW heater and two preheat tanks were comprised of 3.19 million Btu of solar energy, and 0.85 million Btu of auxiliary thermal energy supplied to the DHW heater. (A septic tank problem at the boy's dormitory in the past month necessitated increased use of the DHW subsystem in the recreation center. This increased usage resulted in a performance increase of the subsystem during the month.)

Space Heating Load - To maintain an average indoor temperature of 79°F for the gymnasium, the solar energy system at Scattergood School provided 100 percent of the indicated space heating demand of 11.52 million Btu.

The space heating demand for June was expected to be 0.48 million Btu. However, the actual space heating demand was 11.52 million Btu. The discrepancy between the expected and actual space heating demands is due to excess solar energy contributions to the gymnasium. A motorized damper leak and natural convection transfer of energy from rock storage are the sources of the excess solar heating. This condition is discussed in detail in the observation section of this report.

D. Observations

The large transport loop energy losses may be caused by leakage through manual slide dampers. The leaky dampers could result from inadequate sealing of the manual dampers after the solar energy system was converted from the summer to winter operation in October 1978, and from grain drying operation to space heating in November 1978. Another source of transport loop leakage is the collector plenums. As the system ages, the connections between the collectors and the plenums may begin to leak. An investigation will be performed to ascertain the cause of the collector transport leaks during checkout of the additional measurement sensors to be installed next month.

The excess solar energy delivered to the gymnasium was caused by two situations. First, the solar system was operated generally in the storage and hot water preheating modes due to the lack of a space heating load during the month. In the hot water or rock storage heating modes, a 12 percent leak rate in motorized damper MD-2 allowed energy to be transferred to the gymnasium. During these periods, the gymnasium temperature rises to approximately 80°F. An average gymnasium temperature of 79°F illustrates the effect of the leak. This condition resulted in the transfer of 6.45 million Btu to the gymnasium, which alone was more than sufficient to satisfy the heating demand for this month.

A second source of solar energy results from a continuous low-level natural convection transfer of energy from the rock thermal storage to the gymnasium. The natural convection flow results from a chimney effect produced by the combined effects of a tall gymnasium, cold gymnasium temperatures, and a hot storage which by design is open to the gymnasium when the solar energy system is de-energized. This condition resulted in the transfer of approximately 5.07 million Btu to the gymnasium.

To create habitable conditions in the gymnasium, a propeller exhaust fan in combination with an open gymnasium access door was utilized to remove excess energy in the gymnasium. Thus, additional energy was utilized to run the propeller fan during the summer because of the excess solar energy added to the site.

The leaky motorized damper MD-2 should be adjusted to eliminate the air leak to the gymnasium and the rock thermal storage bypassed to prevent the excess thermal energy transfer to the building during the summer months.

E. Energy Savings

Solar energy space heating savings were 19.19 million Btu of fossil energy (210 gallons of propane) that was obtained at an expense of 0.28 million Btu of electrical energy. The low space heating operating expense is the result of two factors. First, a continuous low-level natural convection transfer of energy exists from the rock thermal storage to the gymnasium. Second, during the day when the solar energy system is heating hot water, a 12 percent leak rate in motorized damper MD-2 (Figure 1) is allowing solar energy to be transferred to the building. This reduces the requirement for controlled transfer using the circulation fan, thus reducing the operating expense.

Energy savings calculations are based on a comparison of the energy requirements of a conventional propane-fired furnace, with an assumed burning efficiency of 60 percent, to the requirements of the solar energy system.

The hot water subsystem operation resulted in an electrical energy savings of 0.31 million Btu (91 kwh). The energy savings calculations are based on a comparison of the projected energy requirements of a conventional electrical hot water tank to the energy requirement of the solar energy system. All energy requirements are based on the measured demand for hot water.

III. ACTION STATUS

Instrumentation designed to measure more accurately the hot water subsystem performance and to measure storage subsystem air flow has been specified. These additional sensors, along with the Materials Assessment Program package, have been sent to the site. The additional sensors were installed during the last week of June. Sensor checkout and data system refurbishment will occur in mid-July.

Grain drying air flow sensor W410 is inoperative. The sensor will be repaired in conjunction with the checkout. Storage return temperature sensor T151 and hot water heat exchange temperature T304 have malfunctioned numerous times since November 1978. During these periods, measurement T202 was substituted for measurement T151 and T352 substituted for T304. Sensors T151 and T304 will also be repaired during checkout.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: JUNE,1979

SOLAR/2003-79/06

SITE/SYSTEM DESCRIPTION:
SCATTERGOOD IS A HIGH SCHOOL WITH AN ENROLLMENT OF SIXTY STUDENTS. THE SOLAR SYSTEM PROVIDES HEAT AND HOT WATER FOR A 7,966 SQ.FT. GYMNASIUM. THE SYSTEM UTILIZES AIR AS THE CIRCULATING HEAT TRANSFER MEDIUM AND A 62 TON PEBBLE BED FOR STORAGE. AUXILIARY HEATING IS PROVIDED BY TWO 250K BTU AND ONE 100K BTU PROPANE HEATERS. HOT WATER AUXILLIARY IS A 4.5KW ELECTRIC ELEMENT IN THE DOMESTIC HOT WATER TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	112.334	MILLION BTU
	45006	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	18.469	MILLION BTU
	7399	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	70	DEGREES F
AVERAGE BUILDING TEMPERATURE	79	DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.13	
ECSS OPERATING ENERGY	0.568	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.828	MILLION BTU
TOTAL ENERGY CONSUMED	20.113	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL	
LOAD	0.618	11.523	N.A.	12.128	MILLION BTU
SOLAR FRACTION	50	100	N.A.	97	PERCENT
SOLAR ENERGY USED	3.190	11.516	N.A.	14.705	MILLION BTU
OPERATING ENERGY	0.233	0.026	N.A.	0.828	MILLION BTU
AUX. THERMAL ENERGY	0.850	0.000	N.A.	0.847	MILLION BTU
AUX. ELECTRIC FUEL	0.850	N.A.	N.A.	0.850	MILLION BTU
AUX. FOSSIL FUEL	N.A.	0.000	N.A.	0.000	MILLION BTU
ELECTRICAL SAVINGS	0.311	-0.026	N.A.	-0.283	MILLION BTU
FOSSIL SAVINGS	N.A.	19.193	N.A.	19.193	MILLION BTU

SYSTEM PERFORMANCE FACTOR: 2.171

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: JUNE,1979

SOLAR/2003-79/06

SITE/SYSTEM DESCRIPTION:
SCATTERGOOD IS A HIGH SCHOOL WITH AN ENROLLMENT OF SIXTY STUDENTS. THE SOLAR SYSTEM PROVIDES HEAT AND HOT WATER FOR A 7,966 SQ.FT. GYMNASIUM. THE SYSTEM UTILIZES AIR AS THE CIRCULATING HEAT TRANSFER MEDIUM AND A 62 TON PEBBLE BED FOR STORAGE. AUXILIARY HEATING IS PROVIDED BY TWO 250K BTU AND ONE 100K BTU PROPANE HEATERS. HOT WATER AUXILLIARY IS A 4.5KW ELECTRIC ELEMENT IN THE DOMESTIC HOT WATER TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	118.512 GIGA JOULES
	511085 KJ/SQ.M.
COLLECTED SOLAR ENERGY	19.485 GIGA JOULES
	84028 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	21 DEGREES C
AVERAGE BUILDING TEMPERATURE	26 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.13
ECSS OPERATING ENERGY	0.600 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.873 GIGA JOULES
TOTAL ENERGY CONSUMED	21.219 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.652	12.157	N.A.	12.795 GIGA JOULES
SOLAR FRACTION	50	100	N.A.	97 PERCENT
SOLAR ENERGY USED	3.365	12.149	N.A.	15.514 GIGA JOULES
OPERATING ENERGY	0.246	0.028	N.A.	0.873 GIGA JOULES
AUX. THERMAL ENG	0.896	0.000	N.A.	0.894 GIGA JOULES
AUX. ELECTRIC FUEL	0.896	N.A.	N.A.	0.896 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	0.000	N.A.	0.000 GIGA JOULES
ELECTRICAL SAVINGS	0.329	-0.028	N.A.	-0.299 GIGA JOULES
FOSSIL SAVINGS	N.A.	20.248	N.A.	20.248 GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 2.171

* DENOTES UNAVAILABLE DATA
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REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: JUNE,1979

SOLAR/2003-79/06

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	4.454	63	0.679	N	0.034	N	0.152
2	5.062	70	0.696	O	0.024	O	0.138
3	4.706	72	0.654	T	0.021	T	0.139
4	3.075	71	0.440		0.013		0.143
5	4.403	70	0.610	A	0.023	A	0.138
6	4.725	74	0.587	P	0.022	P	0.124
7	2.726	73	0.508	P	0.019	P	0.186
8	1.340	68	0.312	L	0.006	L	0.233
9	1.924	70	0.328	I	0.014	I	0.170
10	3.670	60	0.557	C	0.031	C	0.152
11	4.332	69	0.548	A	0.023	A	0.127
12	3.698	70	0.608	B	0.026	B	0.164
13	3.661	67	0.579	L	0.021	L	0.158
14	4.477	73	0.564	E	0.023	E	0.126
15	4.819	78	0.546		0.019		0.113
16	3.944	77	0.552		0.022		0.140
17	3.084	68	0.605		0.023		0.196
18	1.749	62	0.346		0.007		0.198
19	4.149	74	0.460		0.025		0.111
20	4.517	73	0.607		0.017		0.134
21	4.861	75	0.552		0.022		0.114
22	4.616	72	0.538		0.028		0.117
23	1.369	57	0.022		0.000		0.016
24	4.604	63	0.131		0.000		0.028
25	4.841	67	0.405		0.021		0.084
26	4.939	72	0.493		0.025		0.100
27	2.577	72	0.381		0.014		0.148
28	2.754	71	0.389		0.010		0.141
29	2.670	69	0.459		0.012		0.172
30	4.587	72	0.549		0.024		0.120
SUM	112.334	-	14.705	N.A.	0.568	N.A.	-
AVG	3.744	70	0.490	N.A.	0.019	N.A.	0.131
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: JUNE,1979

SOLAR/2003-79/06

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	4.454	3.464	1.211	71	0.272
2	5.062	2.785	1.068	79	0.211
3	4.706	2.433	0.912	82	0.194
4	3.075	1.115	0.417	76	0.136
5	4.403	2.154	0.852	*	0.194
6	4.725	2.388	0.869	84	0.184
7	2.726	1.518	0.669	*	0.245
8	1.340	0.444	0.192	72	0.143
9	1.924	1.012	0.382	73	0.198
10	3.670	2.829	0.833	61	0.227
11	4.332	2.387	0.937	77	0.216
12	3.698	2.481	0.882	79	0.239
13	3.661	2.170	0.761	71	0.208
14	4.477	2.346	0.780	79	0.174
15	4.819	2.177	0.789	84	0.164
16	3.944	2.174	0.705	83	0.179
17	3.084	2.042	0.631	72	0.204
18	1.749	0.654	0.223	64	0.128
19	4.149	2.316	0.807	*	0.194
20	4.517	2.005	0.754	80	0.167
21	4.861	2.342	0.849	84	0.175
22	4.616	3.202	0.894	80	0.194
23	1.369	0.000	0.000	*	0.000
24	4.604	0.000	0.000	70	0.000
25	4.841	2.675	0.365	75	0.075
26	4.939	3.303	0.408	79	0.083
27	2.577	1.337	0.257	75	0.100
28	2.754	1.278	0.286	77	0.104
29	2.670	1.393	0.265	70	0.099
30	4.587	3.410	0.473	81	0.103
SUM	112.334	60.236	18.469	-	-
AVG	3.744	2.008	0.616	76	0.164
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
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N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: JUNE,1979

SOLAR/2003-79/06

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.520	0.204	0.294	134	0.958
2	0.506	0.302	0.149	143	0.890
3	0.414	0.322	-0.036	145	0.691
4	0.151	0.230	-0.182	138	0.316
5	0.327	0.252	0.143	140	1.210
6	0.390	0.252	0.012	142	0.677
7	0.274	0.254	-0.068	140	0.678
8	0.065	0.212	-0.226	134	-0.228
9	0.124	0.156	-0.075	128	0.659
10	0.267	0.177	0.097	128	1.024
11	0.431	0.239	0.175	136	0.961
12	0.328	0.250	0.041	139	0.887
13	0.332	0.253	0.020	140	0.821
14	0.317	0.221	0.023	142	0.770
15	0.362	0.225	0.058	144	0.785
16	0.252	0.211	-0.021	143	0.756
17	0.172	0.225	-0.083	141	0.826
18	0.080	0.219	-0.234	134	-0.194
19	0.322	0.148	0.197	135	1.071
20	0.343	0.282	0.018	139	0.875
21	0.363	0.268	0.073	142	0.939
22	0.814	0.143	-0.069	141	0.092
23	0.000	0.000	-0.073	137	1.000
24	0.000	0.000	-0.088	135	1.000
25	0.619	0.000	-0.139	131	-0.224
26	0.914	0.023	-0.039	127	-0.018
27	0.000	0.000	-0.047	125	1.000
28	0.000	0.000	-0.058	122	1.000
29	0.000	0.003	-0.052	120	-526.809
30	0.000	0.000	-0.036	118	1.000
SUM	8.686	5.072	-0.227	-	-
AVG	0.290	0.169	-0.008	135	0.558
NBS ID	G200	G201	G202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: JUNE,1979

SOLAR/2003-79/06

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.027	55	0.221	0.013	0.039	0.039	N	0.013	N	58	138	38
2	0.018	38	0.181	0.010	0.036	0.036	O	0.002	O	57	138	27
3	0.042	50	0.148	0.008	0.040	0.040	T	0.035	T	68	131	83
4	0.018	63	0.080	0.005	0.029	0.029		0.011		58	139	39
5	0.032	49	0.140	0.009	0.027	0.027	A	0.028	A	60	136	55
6	0.024	62	0.106	0.009	0.014	0.014	P	0.015	P	57	142	34
7	0.024	57	0.092	0.008	0.021	0.021	P	0.011	P	58	142	34
8	0.014	38	0.036	0.003	0.028	0.028	L	0.006	L	58	142	21
9	0.017	35	0.061	0.005	0.030	0.030	I	0.007	I	62	140	26
10	0.018	38	0.097	0.012	0.022	0.022	C	0.003	C	60	139	30
11	0.021	49	0.123	0.009	0.023	0.023	A	0.012	A	58	142	31
12	0.007	34	0.148	0.010	0.032	0.032	B	-0.005	B	60	138	12
13	0.037	51	0.097	0.008	0.019	0.019	L	0.023	L	66	133	70
14	0.016	44	0.113	0.009	0.024	0.024	E	0.005	E	72	132	37
15	0.000	35	0.108	0.007	0.015	0.015		-0.007		82	100	0
16	0.058	53	0.120	0.008	0.027	0.027		0.039		68	127	103
17	0.044	58	0.122	0.009	0.031	0.031		0.022		65	136	81
18	0.001	19	0.046	0.003	0.041	0.041		-0.001		70	125	24
19	0.013	36	0.088	0.010	0.020	0.020		0.003		70	102	18
20	0.028	45	0.101	0.007	0.028	0.028		0.018		64	136	52
21	0.021	46	0.118	0.008	0.018	0.018		0.008		69	134	39
22	0.049	62	0.061	0.011	0.020	0.020		0.033		71	132	88
23	0.000	43	0.000	0.000	0.035	0.035		0.000		75	131	0
24	0.000	12	0.056	0.000	0.058	0.058		0.000		75	131	0
25	0.008	13	0.121	0.008	0.033	0.033		-0.004		65	138	12
26	0.008	22	0.125	0.010	0.027	0.027		-0.003		62	141	12
27	0.015	25	0.116	0.006	0.044	0.044		0.004		65	139	25
28	0.000	12	0.090	0.006	0.034	0.034		-0.006		68	138	0
29	0.010	18	0.090	0.007	0.019	0.019		-0.002		67	141	15
30	0.048	61	0.187	0.014	0.017	0.017		0.040		64	148	70
SUM	0.618	-	3.190	0.233	0.850	0.850	N.A.	0.311	N.A.	-	-	1076
AVG	0.021	50	0.106	0.008	0.028	0.028	N.A.	0.010	N.A.	65	134	36
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: JUNE,1979

SOLAR/2003-79/06

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.458	100	0.458	0.000	0.000	N	0.000	0.000	0.763	75	63
2	0.516	100	0.516	0.000	0.000	O	0.000	0.000	0.860	78	70
3	0.506	100	0.506	0.000	0.000	T	0.000	0.000	0.844	79	72
4	0.360	100	0.360	0.000	0.000		0.000	0.000	0.600	78	71
5	0.470	100	0.470	0.000	0.000	A	0.000	0.000	0.783	77	70
6	0.481	100	0.481	0.000	0.000	P	0.000	0.000	0.802	80	74
7	0.416	100	0.416	0.000	0.000	P	0.000	0.000	0.693	79	73
8	0.277	100	0.277	0.000	0.000	L	0.000	-0.000	0.461	77	68
9	0.267	100	0.267	0.000	0.000	I	0.000	-0.000	0.445	76	70
10	0.460	100	0.460	0.002	0.000	C	0.000	-0.002	0.766	74	60
11	0.426	100	0.426	0.000	0.000	A	0.000	0.000	0.710	78	69
12	0.464	100	0.460	0.000	0.000	B	0.000	0.000	0.767	80	70
13	0.483	100	0.483	0.000	0.000	L	0.000	-0.000	0.805	79	67
14	0.451	100	0.451	0.000	0.000	E	0.000	0.000	0.752	80	73
15	0.438	100	0.438	0.000	0.000		0.000	0.000	0.730	82	78
16	0.432	100	0.432	0.000	0.000		0.000	0.000	0.720	83	77
17	0.470	100	0.483	0.001	0.000		0.000	-0.001	0.804	81	68
18	0.300	100	0.300	0.001	0.000		0.000	-0.001	0.500	76	62
19	0.379	100	0.371	0.000	0.000		0.000	0.000	0.619	80	74
20	0.515	100	0.506	0.000	0.000		0.000	0.000	0.844	81	73
21	0.434	100	0.434	0.000	0.000		0.000	0.000	0.723	83	75
22	0.477	100	0.477	0.000	0.000		0.000	-0.000	0.795	82	72
23	0.022	100	0.022	0.000	0.000		0.000	0.000	0.037	74	57
24	0.075	100	0.075	0.000	0.000		0.000	0.000	0.125	75	63
25	0.284	100	0.284	0.001	0.000		0.000	-0.001	0.473	78	67
26	0.368	100	0.368	0.003	0.000		0.000	-0.003	0.614	79	72
27	0.266	100	0.266	0.003	0.000		0.000	-0.003	0.443	78	72
28	0.299	100	0.299	0.007	0.000		0.000	-0.007	0.499	78	71
29	0.369	100	0.369	0.006	0.000		0.000	-0.006	0.614	78	69
30	0.361	100	0.361	0.002	0.000		0.000	-0.002	0.602	81	72
SUM	11.523	-	11.516	0.026	0.000	N.A.	0.000	-0.026	19.193	-	-
AVG	0.384	100	0.384	0.001	0.000	N.A.	0.000	-0.001	0.640	79	70
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: SCATTERGOOD SCHOOL SOLAR/2003-79/06
REPORT PERIOD: JUNE,1979

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1785	N	63	71	*	0	0
2	2028	O	70	79	*	0	0
3	1886	T	72	82	*	0	0
4	1232		71	76	*	0	1
5	1764	A	70	*	*	0	0
6	1893	P	74	84	*	0	0
7	1092	P	73	*	*	0	0
8	537	L	68	72	*	0	0
9	771	I	70	73	*	0	0
10	1470	C	60	61	*	0	0
11	1736	A	69	77	*	0	0
12	1482	B	70	79	*	0	1
13	1467	L	67	71	*	0	0
14	1794	E	73	79	*	0	0
15	1931		78	84	*	0	0
16	1580		77	83	*	0	0
17	1236		68	72	*	0	0
18	701		62	64	*	0	0
19	1662		74	*	*	0	0
20	1810		73	80	*	0	1
21	1948		75	84	*	0	0
22	1849		72	80	*	0	0
23	548		57	*	*	0	0
24	1844		63	70	*	0	0
25	1940		67	75	*	0	0
26	1979		72	79	*	0	0
27	1033		72	75	*	91	3
28	1103		71	77	*	0	0
29	1070		69	70	*	0	0
30	1838		72	81	*	0	0
SUM	45006	N.A.	-	-	-	-	-
AVG	1500	N.A.	70	76	*	0	0
NBS ID	G001		N113			N115	N114

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*U.S. GOVERNMENT PRINTING OFFICE: 1979-640-189/4047. Region 4.